Arrangement for Noise Abatement in Turbofan Drives

The invention relates to an arrangement for abatement of the noise generated by turbofan drives specifically in the hot gas area.

Active methods are known, e.g., from US 5,386,689, for abatement of the noise generated by turbofan drives in the hot gas area. To do so, sound sources are provided for generating antisound in the hot gas area of the drive.

DE 196 07 290 A1 describes an acoustic absorber consisting of a pot-shaped bottom part in which a single horn extends.

The object of this invention is to create an arrangement with which effective abatement of the noise generated by turbofan drives in the hot gas area can be achieved, whereby the arrangement should have only a low weight in accordance with the requirements of aviation technology.

This object is achieved with the arrangement according to Claim 1. Advantageous embodiments are the subject matter of subordinate claims.

According to this invention, energy is withdrawn from the sound waves generated in the hot gas area of a turbofan drive by means of an absorbent lining of the hot gas area of the turbofan drive and then are no longer emitted. Dissipation is accomplished through viscous losses in the lining, which has the following structure:

– a plurality of adjacent cavities, whereby four horns extend into each cavity,

– the horns with the mouths are attached to a perforated cover plate and the cover plate forms a wall of the hot gas flow channel.

The invention will now be explained on the basis of an exemplary embodiment with reference to the drawings in which:

FIG 1 shows a cross-sectional diagram of a turbofan drive having an inventive acoustically absorbent lining in the hot gas area;

FIG 2 shows a view from above and a cross-sectional view from the front of the absorbent lining; and

FIG 3 shows a diagram of the horn geometry of the absorbent lining.

FIG 1 shows a cross-sectional diagram of a turbofan drive. The fresh air drawn in is divided into two substreams. A first portion is sent past the combustion chamber BK to the nozzle, where it is mixed with hot exhaust gases from the combustion chamber BK (so-called bypass). The other substream is sent via multiple compressor stages VS into the combustion chamber BK (annular cross section) and from there to the nozzle. The flow channel SK, having an annular cross section downstream from the combustion chamber BK, is the hot gas area of the drive in the sense of the present invention. It is equipped with the inventive sound-absorbing lining A, such that the sound-absorbing lining A forms the outer wall of the so-called internal plug IP of the drive.

The absorbent lining A comprises a plurality of essentially cubical cavities HR having an approximately square ground area GF, into which four horns H are introduced (FIG 2). Other ground areas, e.g., in the form of a hexagon are also possible. The horns have a first opening with a larger diameter HM—the so-called mouth of the horn—and a second opening with a smaller diameter—the so-called throat of the horn HH. The horns H are attached to a cover plate AB by spot welding at the mouth of the horn HM. The cover plate AB is perforated in the area of the mouth of the horn HM

(area of the perforation P) with a porosity of at least 20%, especially 30% in a preferred embodiment, whereby the diameter of the holes is 1 mm. The horns H preferably have a circular cross section. The horns do not extend to the ground area GF of a cavity, so that an interspace remains between the throat of the horn HH and the ground area GF.

A cavity HR is bordered by four side faces SF in addition to the cover plate AB and the ground area GF. The cavities are arranged directly side by side without any interspaces in the manner of cassetting and each is separated from the others by a common side wall SF. This yields a very weight-saving design.

FIG 3 shows a specific example of the horn geometry, whereby the dimensions are given specifically (in mm).

Length of the horns (measured axially): 23 mm
Diameter of the mouth of the horn: 23 mm
Diameter of the throat of the horn: 7 mm

The depth of the cavities—measured in the direction of the horn—is 34 mm.

The taper in the horn wall from the mouth of the horn to the throat of the horn need not necessarily be linear. Other forms, e.g., hyperbolic or in the manner of a segment of a circle, are also possible.

The absorbent structure is based on the principle of a Helmholtz resonator. The air mass passing through the perforations into the horns is coupled to the cavity volume surrounding it and thus represents a damped spring-mass system. Use of these absorbers allows the absorption of acoustic energy with a small design height. The dimensions indicated above achieve

the result that maximum absorption in the case of resonance occurs at temperatures around T = 440°C and Mach numbers of M = 0.3. Sound is absorbed here in the frequency range between 830 and 1250 Hz.